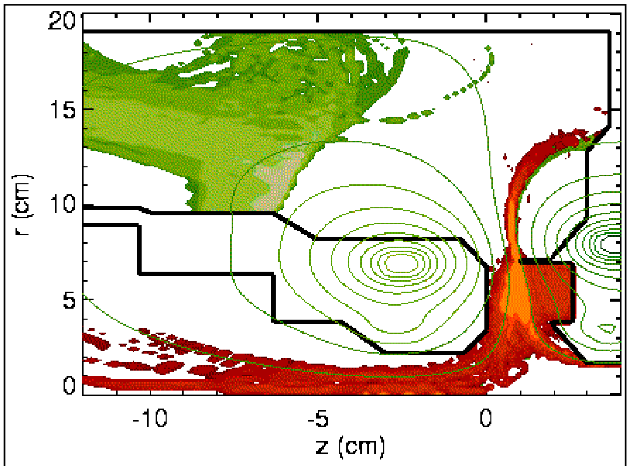
March 1994 Highlights of the Light Ion Inertial Confinement Fusion Program



TWOQUICK simulation of SABRE extraction ion diode, showing feed electrons (in green) and cathode tip electrons (in red).

We obtained data on two PBFA II shots to complete the power coupling series. The remainder of the month was spent on maintenance and on modifications for the parasitic load series. The new Marx triggering system and the rebuilt Marx for SABRE were characterized, and data were obtained on ten extraction ion diode shots.

For passive sources, TWOQUICK simulations of the SABRE diode show feed electrons have a significant effect upon source turn on and evolution of the virtual cathode sheath. To study field geometries that optimize diode performance with cathode tip electrons, experiments were done with a long outer cathode tip to block the feed electron contribution. These experiments and simulations improve our understanding of the field profiles and cathode geometries required for efficient operation of extraction ion diodes. We are designing a new diode geometry that provides better electron confinement within the anode area.

On PBFA II, light from various lines of sight in the anode-cathode gap is transported via fiber optics to multiple spectrometers/streak cameras. A single experimental shot produces 11 streaked spectra in the visible range that show the Stark-shifted neutral Li emission line. Each spectrum is analyzed at 20 time intervals. We developed a semi-automatic process that decreases the time required to analyze the data from several weeks to several days. This improvement allows us to concentrate on developing a physics understanding of the data rather than on data analysis. Our physics understanding is enhanced by comparing the measured electric field distribution and charged particle densities with results from the 3-D, electromagnetic particle-in-cell code QUICKSILVER. Agreement between the data and the simulations is reasonable at early time; however, discrepancies late in time affect the predicted lithium divergence and power coupling. These discrepancies arise at the point where nonuniformities in ion emission and a loss of ion current occur; such phenomena are not currently modeled in the simulations.

Closed cylindrical hohlraums for the May/June lithium target series are designed to reach a high radiation temperature at a given beam intensity. Analytic models and LASNEX simulations predict these targets preserve the optimal surface area to volume ratio of spheres when the diameter and height are equal. A prototype of the target, which contains CH_2 foam at a density of 5 mg/cc, has been fabricated. To determine beam intensity on target, we will measure beam-induced K_α x-rays and beam-induced neutrons.

The National Ignition Facility includes a 192-beam glass laser designed to deliver 1.8 MJ and 500 TW to the entrance holes of a hohlraum. Most conceptual design review activities are now complete. We attended the independent cost evaluation review conducted by Foster Wheeler, Inc. at the end of March.

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